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Forum

Missing link in competitive manufacturing research and practice: Customer-responsive concurrent production

Richard J. Schonberger [a,*], Karen A. Brown [b,1]

[a] 177 107th Ave. NE, #2101, Bellevue, WA 98004, USA
[b] Thunderbird School of Global Management, 1 Global Place, Glendale, AZ 86001, USA

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ABSTRACT

Manufacturing management, in its evolving theory, research, and practice, is plagued by mindsets that are narrowly focused on factory efficiency, with insufficient emphasis on customer responsiveness and its dominant role in competitiveness. In our presentation of these issues we describe and advocate customer-oriented manufacturing practices, in the realm of factory infrastructure. This approach, which we call concurrent production or CP, involves configuring, equipping, and operating factories with a primary focus on synchronization with customer demand. We call on OM researchers to consider these topics in furthering the cause of market competitiveness.

1. Introduction

The manufacturing arm of operations management (OM) has limited itself to a narrow vision of what this key organizational function is supposed to be and do. OM scholars have quibbled about efficiency in factory and supply-chain operations (see Sidebar 1 about what we call the "terminology jungle"), while giving little attention to tying production forward to end customers. Our view is that this single-minded focus on efficiency has effectively knocked OM research, theory, topics, methods, measures, and practitioner guidance off kilter.

On the industry side, a narrow view of OM mirrors the single-minded focus that we observe in academia. Manufacturers proudly display factories that have been cleared of targeted wastes and are marvels of short flow times, low work-in-process inventories, and high capacity utilization. They may also point to similar achievements with key suppliers. A closer look, however, often reveals a supply chain with extended lead times and swollen finished-goods inventories that dwarf the low in-plant inventories (Schonberger, 2016). The overall supply chain often loses the ability to compete on anything except cost. The resulting vulnerability to low-cost competition leads to offshoring.

Inability to synchronize with downstream demand increases production cost through supply-demand mismatches, delays in addressing quality issues—even mass product recalls, and customer defections. These negative outcomes are commonplace even in factories held up as bastions of "best practices". The acronym VUCA (volatile, uncertain, complex, and ambiguous) has been coined to describe how customer demand has been evolving across most industries (Bennett and Lemoine, 2014). Manufacturers continue to expand their product mixes and variants, eventually approaching mass customization (Yavuz and Akçali, 2007). Our objective is to zero in on *concurrent production* (*CP*),[1] designing manufacturing to make production concurrent with end-customer usage. After briefly describing CP and reviewing its place in the

* Corresponding author.
E-mail address: sainc17@centurylink.net (R.J. Schonberger).
[1] Deceased.

[1] A synonym is simultaneous production, used, for example, by Nicholas (1998, p. 198).

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Sidebar 1. Terminology Issues.

In this article we deliberately avoid, where we can, what might be called the "terminology jungle." Terms, acronyms, and foreign or copyrighted words such as TPS, JIT, lean, kaizen, takt time, Six Sigma (capitalized only because it was copyrighted that way), pull and push systems, supply-chain management, mass production, and agility have their uses. But just defining them herein would introduce controversies that could make this paper intolerably long, and unnecessarily detract from main themes and messages. Thus we endeavor to state our case using plain language, although tying our themes to related OM theory necessarily includes some of the contentious terminology.

operations literature (Section 2), we use examples from our experience in manufacturing to illustrate its use and how it differs from traditional manufacturing approaches.

Concurrent production calls for equipping factories with multiple productive units—machines, machine clusters or cells, fill-and-pack and assembly lines—using simple, inexpensive, focused equipment that operates at a pace matched to end-customer usage rates rather than maximum speed. So configured, a plant can easily synchronize its production to actual demand. Equipment is allowed to sit idle in the absence of demand. The objective of CP is responsiveness in the eyes of end customers, combining short lead times with high conformance quality to offer high adaptability to demand fluctuations. Profitability increases because of reduced distribution inventories, fewer quality and maintenance issues, higher sales growth, and better customer retention.

Concurrent production differs from the conventional *sequential production* approach to manufacturing, where a large volume of items is produced on relatively few machines or production lines, and where orders are produced in sequence rather than concurrently. Under sequential production, parts wait their turn to be produced, and equipment is scheduled to maximize utilization rather than responsiveness.

The benefits of CP are generally acknowledged, but its implementation pathway is rife with obstacles: dysfunctional mindsets and ingrained practices, biases, and inability to manage risk.

A major deterrent to CP adoption is the tendency both in companies and among the OM academic community to focus on localized efficiency to the neglect of responsiveness in fulfilling customer needs (Schonberger, 2011). Manufacturing people have limited interaction with final users, so the cost of valuing efficiency above responsiveness goes unnoticed. In consequence, manufacturing-improvement efforts tend to be limited to pursuit of within-factory efficiencies: short internal flows, smoothed schedules, and high capacity utilization.

SP machines typically produce not to customer demand or usage, but at magnitudes faster. To help offset high costs of equipping with such machines, factory supervisors may feel obliged to run many hours and shifts per week, which can eat into time needed for maintenance. They may be pressed to do so by the machine-utilization metric: a standard indicator in conventional manufacturing, but one that has become an object of widespread criticism (see Sidebar 2).

The utilization issue also applies to production associates. SP manufacturers in their quest for operational efficiency prefer factory operatives to be always busy making products. CP, on the other hand, welcomes the situation in which both equipment and its operators are idle for lack of current demand.[2] Hopp and Spearman (1996, pp. 287–288) provide the needed insight: "If a system increases utilization without making any other changes, average cycle times will increase in a highly nonlinear fashion."

A Swedish producer of electronic office equipment spent 2.5 years in converting an existing SP plant to cellular manufacturing, and its efforts in doing so (described by Åhlström and Karlsson, 1996) illustrate the importance of appropriate cost allocation to success with CP. Each step of the conversion was threatened with curtailment because of the company's conventional productivity, unit cost, and utilization metrics. A variety of countermeasures kept the Swedish effort afloat, ending with full adoption of multiple cells in the company's plants, at which point the case-study authors described the transition in performance measurement that occurred: "the level of the unit of analysis was raised … Achieving high load factors in terms of utilization of single machines and employees is no longer relevant. The output of the total system is important and the focus lies on the production of fault-free products in the right number at the right time" (p. 51). That case study dates back about two decades, a period that has seen increasing attention to high-precision methods for costing products and processes. A recent survey of senior managers in large companies (Cokins et al., 2015) suggests that the same issues continue to hold. Despite many years in which the financial function has promoted ABC and related methods, and the clear value of more accurate costing, the authors say, "it's apparent that organizations … are providing inaccurate and misleading information to their users …" (p. 31).

Another managerial mindset that hinders CP implementation is the assumption that it is better to reduce changeover times on a single piece of equipment than to duplicate that equipment. Along similar lines, we have seen manufacturers replacing multiple units with a single large, flexible piece of equipment. Duramatic Products (Glenville, GA), for example, went from multiple to one production line "… in support of a one-piece flow" objective (Blanchard, 2014, p. 27). Case New Holland (Wichita, KS) "… combined two dedicated assembly lines into a single line capable of mixed-model production," done for the sake of "… improved efficiency and productivity" (Jusko, 2012). This way of thinking culminates in "monument" machines (Sidebar 3): high-speed, multi-functional equipment that gives the impression of being extremely efficient. Ligus (2008, p. 8)

Sidebar 2. Utilization: Negative Views.

- Nicholas (1998, p. 746): Machine utilization criteria foster acquisition of "… large, fast machines … few in number …" This complicates job routings, increases WIP, stretches production lead times, and reduces "… responsiveness and flexibility of the plant as a whole."
- Hay (1988, p. 212): Utilization is a valid measure only "… when a company is trying to decide whether or not to buy more equipment, [otherwise conveying] that idle equipment is bad."
- Hall (1987, pp. 133–134): "Harley-Davidson [early 1980s] adopted the correct solution …. Management threw the equipment utilization report into the trash can …"

[2] The machine-utilization metric is of value in continuous-process manufacturing—a power plant or cement factory—where costly maintenance failures can be captured by utilization numbers.

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